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(54) **EMERGENCY EGRESS IN A BLENDED WING BODY AIRCRAFT**

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(51) **Int. Cl.**

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B64C 1/14	(2006.01)
B64D 25/14	(2006.01)
B64C 39/10	(2006.01)
B64C 1/10	(2006.01)

(52) **U.S. Cl.**

CPC ***B64D 11/00*** (2013.01); ***B64C 1/10*** (2013.01); ***B64C 1/1423*** (2013.01); ***B64C 1/22*** (2013.01); ***B64C 39/00*** (2013.01); ***B64C 39/10*** (2013.01); ***B64D 25/14*** (2013.01); *B64C 2039/105* (2013.01)

(58) **Field of Classification Search**

CPC B64D 11/00; B64D 25/14; B64D 25/00; B64C 39/00; B64C 1/22; B64C 1/1423; B64C 39/10; B64C 1/10; B64C 2039/105

See application file for complete search history.

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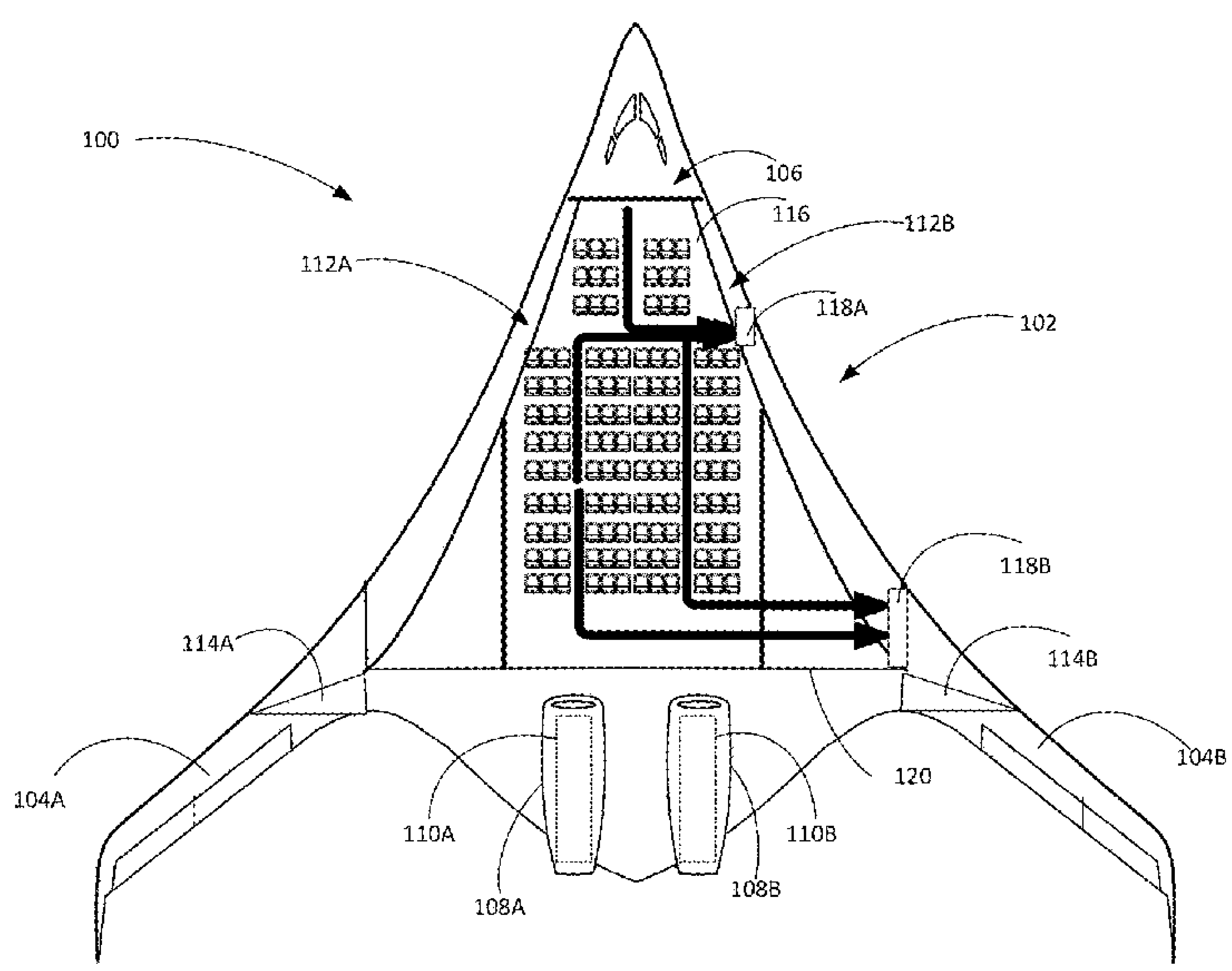
(57) **ABSTRACT**

Technologies for providing emergency egress routes for a blended wing body aircraft are described herein. In some examples, the emergency egress routes are through a side cabin bulkhead and aft one or more cargo holds. In some examples, the blended wing body aircraft has wings that are high geometry wings. In these examples, the emergency egress routes do not penetrate an aft spar, reducing weight and increasing the integrity of the aircraft.

9 Claims, 2 Drawing Sheets



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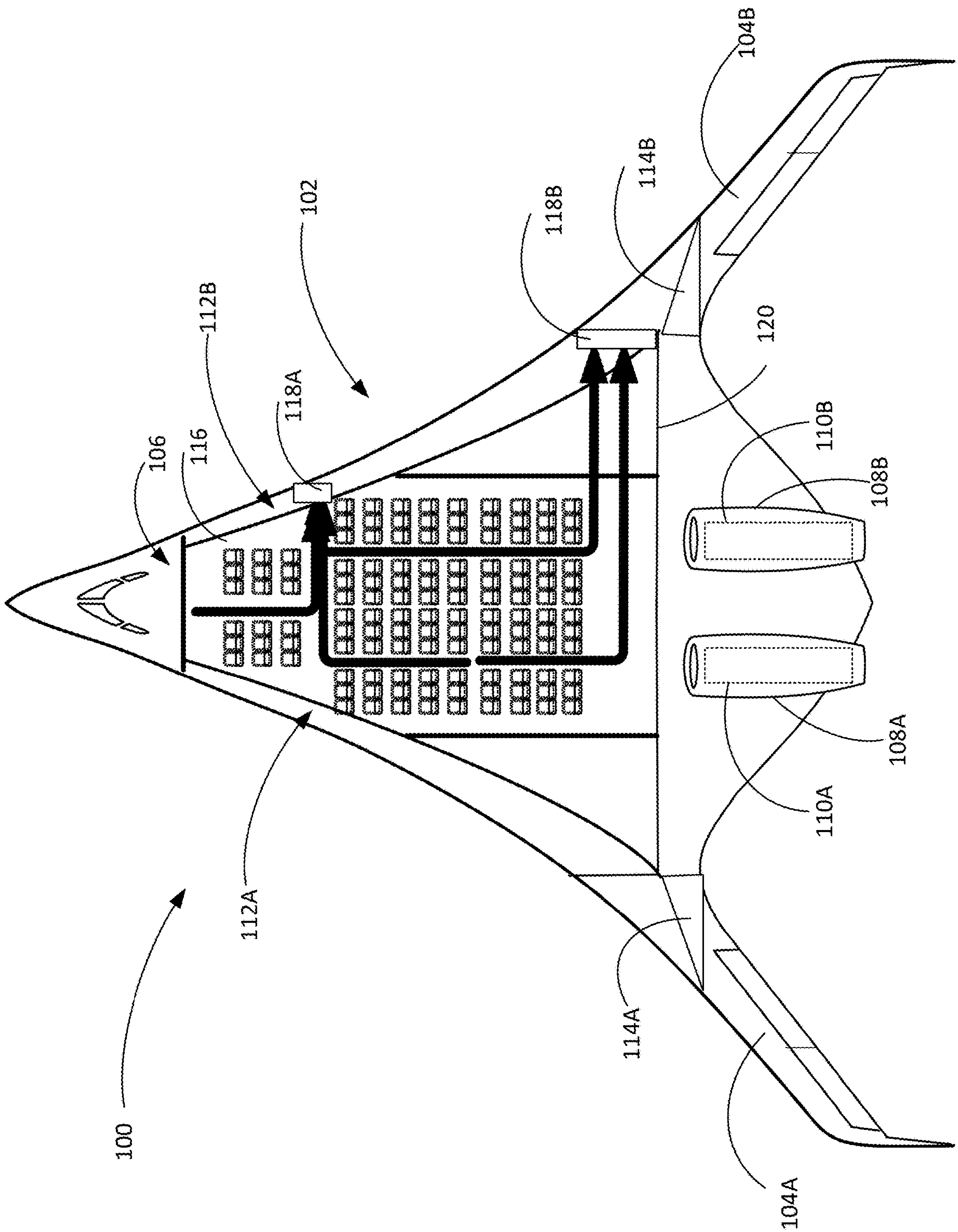
100
102
104A
104B
106
108A
108B
110A
110B
112A
112B
114A
114B
116
118A
118B
120

FIG. 1

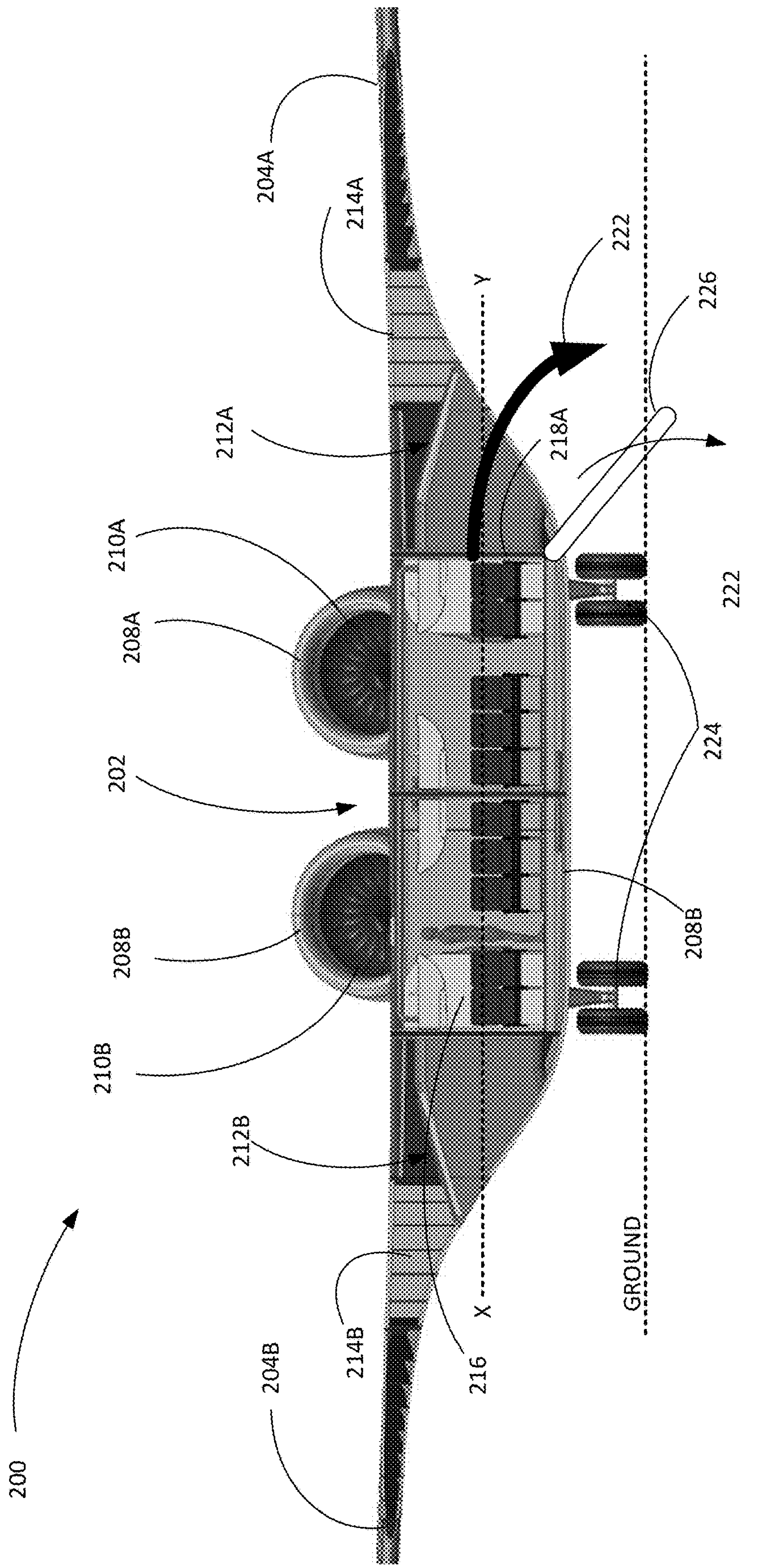
200
204A
214A
222
Y
226
212A
218A
210A
208A
222
202
224
208B
208B
210B
212B
GROUND
X
204B
214B
216

FIG. 2

EMERGENCY EGRESS IN A BLENDED WING BODY AIRCRAFT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 62/786,615 filed Dec. 31, 2018, which is incorporated herein by reference in its entirety.

BACKGROUND

Conventional aircraft consist essentially of a wing section and a fuselage. This so-called "tube and wing" configuration enables convenient packaging of passengers and cargo, but has certain drawbacks. In most cases, passengers are seated on a deck disposed approximately on the vertical centerline of the fuselage, while cargo is stowed beneath. This enables a relatively wide, flat floor for seats and separates cargo operations from passenger loading and unloading. Passengers can be loaded via one or more passenger doors, while cargo can be loaded from one or more cargo hatches on the underside or sides of the fuselage. This configuration also provides a relative constant fuselage cross section (less the nose and tail cones), enabling a substantially percentage of the available volume of the fuselage to be utilized.

As in other airplane types, emergency egress is an important consideration for a blended wing body ("BWB") aircraft. In a BWB configuration, both the fuselage and the wing provide lift. As the name implies, the blended wing blends the wing and fuselage together to provide a single, lift-producing body. In this configuration, the fuselage serves to both carry passengers and/or cargo and to provide a significant portion of the lift. As a result, the wing portion can be smaller for a given payload. Thus, blended wing aircraft tend to have significantly lower overall drag and can carry larger payloads while consuming less fuel.

When designing BWB aircraft, one of the most important design considerations are emergency egress routes. Emergency egress routes are one or more routes by which passengers and crew take to escape from the aircraft. In conventional BWB aircraft, emergency egress routes can be difficult to establish because of various structural limitations. For example, fuel tank locations located across sidewalls of a main cabin can be problematic. In these instances, conventional BWB aircraft may have egress routes added through a rear-spar/aft-bulkhead. This may cut away, or reduce, important shear structure and may add lengthy tunnels from the bulkhead to a trailing edge. An additional problem with this scheme may be the height of the trailing edge route from the ground for both gear up and gear down landings. Exit routes that open beneath the airplane needed an airbag or other solution to raise the aft end for gear down landings. All of this may add weight, cost, and complexity.

SUMMARY

In a single deck (level) BWB aircraft, examples of a configuration of an aircraft interior and exterior that provide for emergency egress routes is described. In some examples, the BWB aircraft includes cargo holds that are located outboard of a main cabin of the BWB aircraft. The BWB aircraft has one or more egress routes through a side cabin bulkhead behind the cargo holds without perforating or penetrating a rear spar of the BWB aircraft.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a top-down view illustration of a BWB aircraft having multiple egress routes, according to some examples disclosed herein.

FIG. **2** is a front view illustration of a BWB aircraft having multiple egress routes, according to some examples disclosed herein.

DETAILED DESCRIPTION

Examples of the present disclosure related generally to providing for emergency egress routes in a BWB aircraft. In some examples of the presently disclosed subject matter, the egress routes provide a lighter exit scheme over conventional BWB aircraft and can reduce the amount of internal (cabin) volume than what would be required in a conventional rear ramp approach.

As briefly noted above, conventional BWB aircraft may have egress routes that penetrate a rear spar **120** of the BWB aircraft. Often, this increases the weight of the aircraft, as the penetration through the rear spar **120** has to be bolstered with support systems, such as additional material, to ensure a stable spar capable of providing the support required of the rear spar.

In various examples of the presently disclosed subject matter, the BWB aircraft includes cargo holds that are located outboard of a main cabin of the BWB aircraft. The BWB aircraft has one or more egress routes through a side cabin bulkhead behind the cargo holds without perforating or penetrating a rear spar **120** of the BWB aircraft. In some examples, this configuration exploits the geometry of a single deck BWB with cargo holds outboard of the main cabins. The egress route can be through the side cabin bulkheads just behind the cargo holds. The lateral exit exploits high wing geometry to shorten the exit tunnel considerably. Further, the egress routes do not perforate the critical rear-spar/aft-bulkhead **120**.

In some examples, there are 2 exits doors for each exit route. One is between the main cabin and cargo hold. The second is at the tunnel exit on the outer lower surface of the wing with an incline suitable for passenger travel, such as roughly 35 degrees included up from the ground facing outward. The exit route is fully in front the of the rear-spar/aft-bulkhead and exits the lower surface a few above ground level for gear-up and about 5 feet above ground level for gear extended. The outer door can serve as a ramp as well or inflatable slides can be used to bridge the gap between the exit and ground. The benefit can be a much lighter exit scheme that requires dramatically less internal volume than a rear ramp approach.

FIG. **1** is a top-down view illustration of a BWB aircraft **100** having multiple egress routes, according to some examples disclosed herein. As illustrated in FIG. **1**, the BWB aircraft **100** includes a fuselage **102**. The fuselage **102** includes a port wing **104**A and a starboard wing **104**B that are continuously coupled to a nose section **106** of the BWB aircraft **100**. The fuselage **102** and wings **104**A and **104**B are each illustrated to have positive sweep angles. The BWB aircraft **100** further includes nacelle **108**A that houses port main engine **110**A and nacelle **108**B that houses starboard main engine **110**B. The BWB aircraft of FIG. **1** is a single deck BWB aircraft configuration, though various examples of the presently disclosed subject matter can be used with different BWB aircraft having more than one deck.

The BWB aircraft **100** includes a port cargo hold **112**A and a starboard cargo hold **112**B. In some examples, the cargo holds **112**A and **112**B are pressurized cargo holds designed to hold passenger cargo (suitcases and the like) as well as, in some examples, animal transport. The BWB aircraft **100** further includes port fuel tank **114**A and starboard fuel tank **114**B. It should be noted that the size and location of various structures, such as the cargo holds **112**A and **112**B, as well as the fuel tanks **114**A and **114**B are illustrated merely as an example, as other sizes, locations, and configurations may be used and are considered to be within the scope of the presently disclosed subject matter.

As shown in FIG. **1**, there are multiple egress routes, generally indicated by arrows through the main cabin **116** of the BWB aircraft **110**. Emergency egress routes are a part of the design of passenger carrying aircraft. The emergency egress routes are to provide for safe passage out of the main cabin **116** to the outside in case of an emergency. Although dependent on aircraft design, it is preferable to have at least two routes by which passengers can egress the BWB aircraft **100** through an exit to the outside of the BWB aircraft **100**. As illustrated, the BWB aircraft **100** includes exits **118**A and **118**B designed as exits for the emergency egress routes. It should be noted that exits **118**A and **118**B, as well as other exits not illustrated in FIG. **1**, can be used in normal operations as exits for the BWB aircraft **100**. The exits **118**A and **118**B are not required to be used exclusively as emergency exits, though the exit **118**A and/or **118**B can be designed to be used exclusively as an emergency exit.

FIG. **2** is a front-view illustration of a main cabin of a BWB aircraft **200** having a high wing geometry. Shown in FIG. **2** is the BWB aircraft **200** with a fuselage **202**. The fuselage **202** includes a port wing **204**A and a starboard wing **204**B. The fuselage **202** and wings **204**A and **204**B are each illustrated to have positive sweep angles. The BWB aircraft **200** further includes nacelle **208**A that houses port main engine **210**A and nacelle **208**B that houses starboard main engine **210**B. The BWB aircraft **200** of FIG. **2** is a single deck BWB aircraft configuration, though various examples of the presently disclosed subject matter can be used with different BWB aircraft having more than one deck.

The BWB aircraft **100** includes a port cargo hold **212**A and a starboard cargo hold **212**B. In some examples, the cargo holds **212**A and **212**B are pressurized cargo holds designed to hold passenger cargo (suitcases and the like) as well as, in some examples, animal transport. The BWB aircraft **100** further includes port fuel tank **214**A and starboard fuel tank **214**B. It should be noted that the size and location of various structures, such as the cargo holds **212**A and **212**B, as well as the fuel tanks **214**A and **214**B are illustrated merely as an example, as other sizes, locations, and configurations may be used and are considered to be within the scope of the presently disclosed subject matter.

The BWB aircraft **200** includes exit **218**A, which may be used as an emergency egress route. The BWB aircraft may include other exits, as in FIG. **1**, that are not illustrated in FIG. **2**. As illustrated, the BWB aircraft **200** is a single-deck (i.e. single passenger floor) BWB-type of aircraft. Further, the BWB aircraft **200** has a high wing geometry, illustrated by wings **204**A and **204**B above centerline XY, which is approximately the center of the height of the BWB aircraft **200** above the floor **220** of the BWB aircraft **200**.

The high wing geometry and the location of the exit **218**A may exit the length of an exit tunnel significantly. In low wing geometry BWB aircraft, one in which the wing is at or near the centerline XY, one or more of the exits from the aircraft may necessary go through at least a part, if not completely through, a wing of the BWB aircraft. The need to go through the wing of a low wing geometry BWB aircraft can increase the length of travel from a main cabin of the low wing geometry BWB aircraft to the outside, as the passenger needs to travel at least partially through the wing.

In FIG. **2**, the BWB aircraft **200** has a high wing geometry, which in some examples significantly shortens the length of travel from the cabin **216** to the outside because the passenger does not need to travel through the wing, as it is above an egress path **222**. Further, using a high wing geometry configuration, the egress path **222** is closer to the ground. In some examples, with landing gear **224** up (raised or within the fuselage **202** of the BWB aircraft **200**), the egress path **222** may be near ground level. With the landing gear **224** down (lowered or below the fuselage **202** of the BWB aircraft **200**), the egress path **222** may be 5 or 6 feet above the ground (the height of the landing gear **224**). In some examples, an exit door **226** may be configured to provide a ramp to assist passengers in exiting the BWB aircraft **200**. The exit door **226**, or another structure of the BWB aircraft **200**, may also include an inflatable slide (not illustrated).

While several possible embodiments are disclosed above, embodiments of the present invention are not so limited. For instance, while several possible configurations of hydraulic cylinders, linear actuators, valves, and motors, other suitable actuators and controls could be selected without departing from the spirit of embodiments of the invention. In addition, the location and configuration used for various features of embodiments of the present disclosure can be varied according to a particular aircraft, airport, or landing gear design that requires a slight variation due to, for example, size or weight constraints, runway length, aircraft type, or other factors. Such changes are intended to be embraced within the scope of the invention.

The specific configurations, choice of materials, and the size and shape of various elements can be varied according to particular design specifications or constraints requiring a device, system, or method constructed according to the principles of the invention. Such changes are intended to be embraced within the scope of the invention. The presently disclosed embodiments, therefore, are considered in all respects to be illustrative and not restrictive. The scope of the invention is indicated by the appended claims, rather than the foregoing description, and all changes that come within the meaning and range of equivalents thereof are intended to be embraced therein.

What is claimed is:

1. A blended wing body (BWB) aircraft comprising:
a main cabin configured to hold passengers during flight;
at least one cargo hold located outboard of the main cabin; and
at least one egress route through a side cabin bulkhead;
wherein the side cabin bulkhead is located aft of the at least one cargo hold, at least a portion of the side cabin bulkhead is located forward a trailing edge of at least a wing, and the at least one egress route does not penetrate a rear spar of the aircraft.

2. The BWB aircraft of claim **1**, wherein the at least one egress route comprises a first door between the main cabin and the at least one cargo hold and a second door at a tunnel exit on an outer lower surface of the at least a wing of the BWB aircraft.

3. The BWB aircraft of claim **2**, wherein the second door, when opened for egress from the BWB aircraft, has a ramp suitable for passenger travel.

4. The BWB aircraft of claim **2**, further comprising an inflatable slide proximate to the second door, wherein the inflatable slide is used to facilitate travel of passengers from the BWB aircraft.

5. The BWB aircraft of claim **1**, further comprising a second egress route through the side cabin bulkhead forward of the at least one cargo hold.

6. The BWB aircraft of claim **2**, wherein the at least one cargo hold is pressurized.

7. The BWB aircraft of claim **2**, wherein the BWB aircraft is a single deck BWB aircraft.

8. The BWB aircraft of claim **1**, wherein the at least one cargo hold has a height substantially no less than the main cabin.

9. The BWB aircraft of claim **1**, further comprising at least one wing continuously coupled to a nose of the BWB aircraft, the at least one wing having a high wing geometry located above a center of height of the BWB aircraft.

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